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# Arsenic Groundwater Contamination in Middle Ganga Plain, Bihar, India: A Future Danger?

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**Running Title:** Arsenic in the Middle Ganga Plain.

**Key Words:** arsenic poisoning; Ganga plain; Semria Ojha Patti village; childhood poisoning; neurotoxicity; reproductive toxicity.

**List of abbreviations:** PMB = Padma Meghna Bramhaputra, BGS = British Geological Survey, FI-HG-AAS = Flow injection hydride generation atomic absorption spectrometry, SCM = Subhas Chandra Mukherjee, WHO = World Health Organization, SMP = Spotted melanosis on palm, DMP = Diffuse melanosis on palm, SMT = Spotted melanosis on trunk, DMT = Diffuse melanosis on trunk, LEU = Leuco melanosis, WBM = Whole body melanosis, SKP = Spotted keratosis on palm, DKP = Diffuse keratosis on palm, SKS = Spotted keratosis on sole, DKS = Diffuse keratosis on sole, DOR = Dorsal keratosis, CC = Conjunctival congestion.

**ABSTRACT**

The pandemic of arsenic poisoning due to contaminated groundwater in West Bengal, India and all of Bangladesh has been thought limited to the Ganges Delta (the Lower Ganga Plain) despite early survey reports of arsenic contamination in groundwater in the Union Territory of Chandigarh and its surroundings in the northwestern Upper Ganga Plain and recent findings in the Terai area of Nepal. Anecdotal reports of arsenical skin lesions in villagers led us to evaluate arsenic exposure and sequelae in the Semria Ojha Patti village in the Middle Ganga Plain, Bihar, where tube wells replaced dug wells about 20 years ago. Analyses of the arsenic content of 206 tube wells (95% of the total) showed 56.8% to exceed arsenic concentrations of 50 μg/L with 19.9% >300 μg/L, the concentration predicting overt arsenical skin lesions. On medical examination of a self-selected sample of 550 (390 adults; 160 children), 13% of the adults and 6.3% of the children had typical skin lesions, an unusually high involvement for children, except in extreme exposures combined with malnutrition. The urine, hair, and nail concentrations of arsenic correlated significantly (r=0.72–0.77) with drinking water arsenic concentrations up to 1654 μg/L. On neurological examination, arsenic-typical neuropathy was diagnosed in 63% of the adults, a prevalence previously seen only in severe, subacute exposures. We also observed an apparent increase in fetal loss and premature delivery in the women with the highest drinking water arsenic. The possibility of contaminated groundwater at other sites in the Middle and Upper Ganga plain merits investigation.